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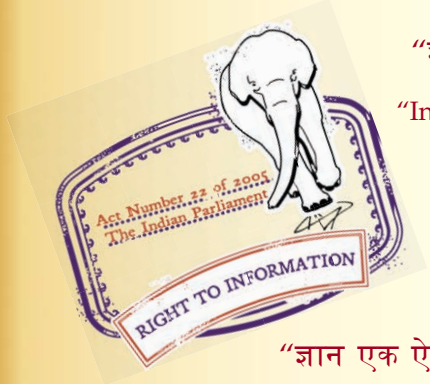

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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS: 3516 - 1966
(Reaffirmed 2005)

Indian Standard

SPECIFICATION FOR CAST IRON PIPE FLANGES AND FLANGED FITTINGS FOR PETROLEUM INDUSTRY

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NEW DELHI 110002

Gr 7

December 1966

Indian Standard

SPECIFICATION FOR CAST IRON PIPE FLANGES AND FLANGED FITTINGS FOR PETROLEUM INDUSTRY

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Indian Standard

SPECIFICATION FOR CAST IRON PIPE FLANGES AND FLANGED FITTINGS FOR PETROLEUM INDUSTRY

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 28 February 1966, after the draft finalized by the Cast Iron and Malleable Cast Iron Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 With the establishment of a number of refineries in the country and proposals to develop the oil industry, it became necessary to formulate this standard. In view of the international character of the petroleum industry, considerable assistance was derived from the following standards:

B.S.1575: 1949 Cast iron pipe flanges and flanged fittings, Class 125, for the petroleum industry. British Standards Institution.

API STD 6A-1963 Wellhead equipment (production valves flanges, blowout preventers and wellhead fittings). American Petroleum Institute.

ASA B 2.1-1960 Pipe threads (except dryseal). American Standards Association.

ASA B 16 a-1939 Cast iron pipe flanges and flanged fittings, Class 125. American Standards Association.

0.3 For the benefit of the manufacturers, the approximate weights of flanges and flanged fittings of the sizes and types that are in general use have been given in Appendix A.

0.4 As a common practice, the pipe flanges and flanged fittings covered by this specification are threaded and gauged at present in accordance with API STD 6A-1963 for line-pipe thread for sizes up to and including 508 mm and for sizes over 508 mm in accordance with ASA B 2.1-1960. IS: 3333* covering basic profile, dimensions and tolerances for pipe threads for petroleum industry is under preparation. In the meantime, the relevant API and ASA Standards given under **0.2** may be used.

*Basic profile, dimensions and tolerances for line-pipe threads for pipe fittings for petroleum industry (Under preparation) (since printed in 1967 and split into parts).

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements for cast iron pipe flanges and flanged fittings for petroleum industry

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of cast iron pipe flanges and flanged fittings shall be as laid down in IS: 1387-1959†.

3. PRESSURE AND TEMPERATURE RATING

3.1 The flanges and flanged fittings covered by this specification shall be rated for liquid, gas and saturated steam services as follows:

Service Temperature °C	Maximum Non-shock Service Pressure Rating, kgf/cm²		
	Size 27-305 mm	Size 356-610 mm	Size 762-914 mm
0-65	12·3	10·5	10·5
93	11·5	9·6	8·2
121	10·6	8·7	5·8
148	9·8	7·8	3·5‡
170	9·1	7·0‡	—
178	8·8‡	—	—

4. DESIGNATION

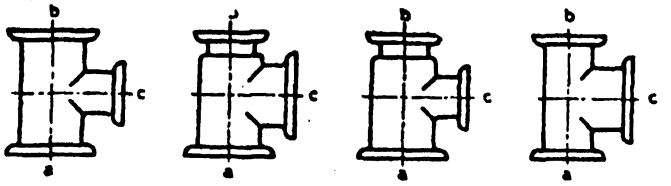
4.1 The flanges and flanged fittings shall be designated by their corresponding nominal pipe size.

4.2 Reducing fittings shall be designated by the sizes of the openings, in their proper sequence (*see* Fig. 1).

*Rules for rounding off numerical values (*revised*).

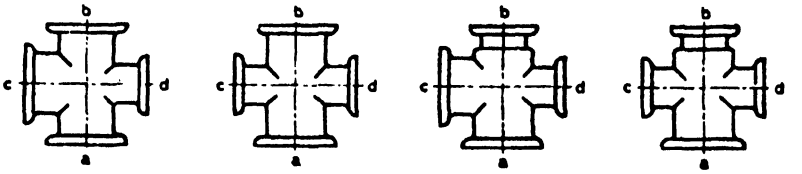
†General requirements for the supply of metals and metal products. (Since revised).

‡Saturated steam service rating.



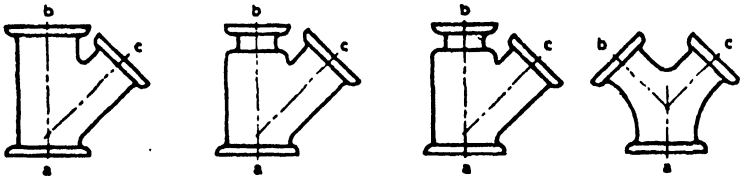
Reducing on Outlet | Reducing on One Run | Reducing on One Run and Outlet | Reducing on Both Runs (Bullhead)

REDUCING TEES



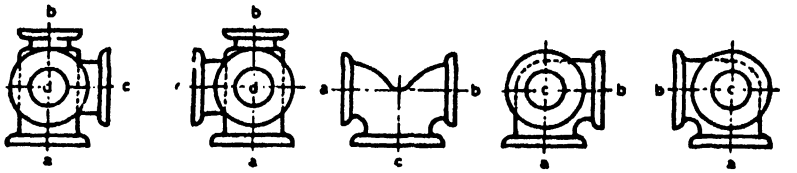
Reducing on One Outlet | Reducing on Both Outlets | Reducing on One Run and Outlet | Reducing on One Run and Both Outlets

REDUCING CROSSES



Reducing on Branch | Reducing on One Run | Reducing on One Run and Branch | True Y

REDUCING LATERALS



Right Hand SIDE-OUTLET | Left Hand TEE | DOUBLE-BRANCH ELBOW | Right Hand SIDE-OUTLET | Left Hand ELBOW

FIG. 1 METHOD OF DESIGNATING OUTLETS OF REDUCING FITTINGS

5. QUALITY OF MATERIAL

5.1 Castings — Cast iron pipe flanges and flanged fittings shall be produced under regular control of chemical and physical properties by any recognized process. The manufacturer shall certify that his product has been so produced that the physical properties thereof, as proved by test specimens, conform to the following requirements:

For flanges and fittings 305 mm and under	Grades 15 or 20 of IS: 210-1962*
For flanges and fittings 356 mm and above	Grade 25 of IS: 210-1962*

5.2 Bolts and Nuts — Bolts and nuts meant for use with standard flanges and flanged fittings shall be of steel conforming to symbol '5S' of IS: 1367-1961†.

6. SIZE

6.1 The dimensions of the flanges and flanged fittings shall conform to the sizes given in Tables 1 to 8 (*see* P 14 to 25).

7. SIDE-OUTLET FITTINGS

7.1 Side-outlet elbows, side-outlet tees, and side-outlet crosses shall have all openings on intersecting centre lines. Long-radius elbows with side outlet shall have the side outlet on the radial centre line of the elbow.

NOTE — In designating the outlets of reducing fittings they should be read in the order indicated by the sequence of the letters *a*, *b*, *c* and *d*. In designating the outlets of side-outlet reducing fittings, the side outlet is named last, and in the case of the cross, which is not shown, the side outlet is designated by the letter *s*.

8. CENTRE-TO-FACE DIMENSIONS

8.1 Elbows

8.1.1 The centre-to-face dimensions for equal-size 90° elbows with or without side outlet, 90° long-radius elbows, 45° elbows and double-branch elbows shall be as given in Table 3 (*see* P 16 and 17).

8.1.2 Reducing 90° elbows, reducing 90° long-radius elbows, and reducing double-branch elbows shall have the same centre-to-face dimensions as equal-size fittings given in Table 3, corresponding to the size of the larger opening.

*Specification for grey iron castings (*revised*). (Since revised).

†Specification for technical supply conditions for threaded fasteners. (Since revised).

8.1.3 Reducing side-outlet elbows shall have the same centre-to-face dimensions as equal-size fittings given in Table 3, corresponding to the size of the larger opening.

For 90° long-radius elbows with side outlet, the centre-to-face dimensions of the side outlet shall be the same as dimension *A* given in Table 3 for an equal-size 90° elbow corresponding to the size of the larger opening.

8.1.4 Special degree elbows up to 45° shall have the same centre-to-face dimensions as 45° elbows, and those over 45° and up to 90° shall have the same centre-to-face dimensions as 90° elbows.

The angle designation of an elbow is its deflection from straight line flow and is the angle between the flanged faces.

8.2 Tees, Crosses and Laterals

8.2.1 The centre-to-face dimensions for equal-size tees and crosses, with or without side outlet, and laterals, shall be as given in Table 3.

8.2.2 Reducing tees and reducing crosses, with or without side outlet, and reducing laterals of sizes 406 mm and smaller, shall have the same centre-to-face dimensions as equal-size fittings given in Table 3 corresponding to the size of the largest opening.

8.2.3 For sizes 457 mm and larger, if (a) the outlet of a reducing tee, (b) the branch of a reducing lateral, or (c) the largest outlet of a reducing side-outlet tee, reducing cross, or reducing side-outlet cross is of the same size or smaller than that given in Tables 4 and 5 [short-body pattern (*see* P 18 and 19)], the centre-to-face dimensions given in these tables shall be used. If a branch or any outlet is larger than that given in Tables 4 and 5, the centre-to-face dimensions shall be the same as for the equal-size fittings shown in Table 3 corresponding to the size of the largest opening.

Tees, crosses and laterals, reducing on the run only, shall have the same centre-to-face dimensions as equal-size fittings given in Table 3 corresponding to the size of the largest opening.

8.2.4 Tees reducing on both runs are generally known as ' bull-head ' tees and shall have the same centre-to-face dimensions as equal-size fittings corresponding to the size of the outlet.

8.3 True Y's — Centre-to-face dimensions for equal-size true Y's shall be as given in Table 3. Reducing sizes are considered special and should be made to suit conditions.

8.4 Reducers and Eccentric Reducers — The face-to-face dimensions of reducers and eccentric reducers shall be the same as those given in Table 3 for the larger opening.

9. TOLERANCE

9.1 Centre-to-Face Tolerance — Variations from specified dimensions shall be allowed to the extent given below:

Centre-to-Contact Surface	*Tolerance*
For sizes up to and including 255 mm	±1 mm
For sizes over 255 mm	±1·5 mm
Contact-Surface to Contact-Surface	
For sizes up to and including 255 mm	±1·5 mm
For sizes over 255 mm	±3 mm

9.2 Tolerance on Thickness — Wall thickness of the flanges and flanged fittings shall at no point be less than 87·5 percent of the thickness given in Tables 1 to 8.

10. THREAD OF SCREWED FLANGES

10.1 Cast iron pipe flanges and flanged fittings of sizes up to and including 610 mm shall be threaded and gauged in accordance with IS: 3333*. The threads shall be concentric with the axis of the flange and variations in alignment shall not exceed 0·005 21 mm.

10.1.1 Threads shall be chamfered approximately to the major diameter of the thread at the back of the flange, at an angle of approximately 45° with the axis of the thread for the purpose of easy entrance in making a joint and for the protection of the thread. The chamfer shall be concentric with the thread.

10.1.2 The gauging notch of a working gauge should come flush with the bottom of the chamfer and the maximum allowable thread variations shall be one turn large or one turn small from the gauging notch.

10.2 Cast iron pipe flanges and flanged fittings over 610 mm are not screwed fittings and shall be secured by other methods when used.

11. FLANGE FACING

11.1 Flanges and flanged fittings shall be plain-faced and shall be machined to a tool-mark finish with a feed of approximately 1 mm.

NOTE — In all cases where a cast iron flange is bolted to a steel flange, the latter should be plain-faced, that is, without a projection or raised face.

*Basic profile, dimensions and tolerances for line-pipe threads for pipe fittings for petroleum industry (Under preparation) (since printed in 1967 and split into parts).

12. FLANGE BOLT HOLES

12.1 Bolt holes shall be in multiples of four so that fittings may be made to face any quarter. The bolt holes shall straddle the centre lines. The bolt holes shall be drilled as follows:

	Nominal Size of Bolt
For bolts up to and including 45 mm	+3 mm
For bolts over 45 mm	+6 mm

13. SPOT-FACING

13.1 Flanges — The bolt holes of flanges shall not be spot-faced for ordinary service except in cases given under **13.1.1** to **13.1.4.**

13.1.1 Rough flanges 305 mm and smaller which are oversize more than 3 mm in thickness after facing shall be spot-faced to the minimum thickness of flange given in Table 1 with a plus tolerance of 1·5 mm.

13.1.2 Rough flanges 356 mm up to and including 610 mm which are oversize more than 5 mm in thickness after facing shall be spot-faced to the minimum thickness of flange given in Table 1 with a plus tolerance of 1·5 mm.

13.1.3 Rough flanges 762 mm and larger which are oversize more than 6·5 mm in thickness after facing shall be spot-faced to the minimum thickness of flange given in Table 1 with a plus tolerance of 3 mm.

13.1.4 Where the finish at the back of the flange is such that the bolt head or nut does not bear evenly on the flange surface, the back shall be spot-faced; but such spot-facing shall not reduce the flange thickness below the minimum specified.

13.2 Fittings — The bolt holes of the flanges on cast iron fittings need not be spot-faced on sizes smaller than 457 mm for ordinary service, except as indicated in **13.1.** The bolt holes of all flanges on fittings 457 to 610 mm inclusive, shall be spot-faced to the specified thickness of the flange with a plus tolerance of 1·5 mm and of all flanges on fittings of sizes 762 to 914 mm inclusive, they shall be spot-faced to the tolerance of 3 mm.

14. REINFORCEMENT OF CROSSES AND LATERALS

14.1 Crosses and laterals (Y-branches), both equal and reducing shall, where necessary, be reinforced to compensate for the inherent weakness in the casting design.

9. TOLERANCE

9.1 Centre-to-Face Tolerance — Variations from specified dimensions shall be allowed to the extent given below:

Centre-to-Contact Surface	*Tolerance*
For sizes up to and including 255 mm	±1 mm
For sizes over 255 mm	±1·5 mm
Contact-Surface to Contact-Surface	
For sizes up to and including 255 mm	±1·5 mm
For sizes over 255 mm	±3 mm

9.2 Tolerance on Thickness — Wall thickness of the flanges and flanged fittings shall at no point be less than 87·5 percent of the thickness given in Tables 1 to 8.

10. THREAD OF SCREWED FLANGES

10.1 Cast iron pipe flanges and flanged fittings of sizes up to and including 610 mm shall be threaded and gauged in accordance with IS: 3333*. The threads shall be concentric with the axis of the flange and variations in alignment shall not exceed 0·005 21 mm.

10.1.1 Threads shall be chamfered approximately to the major diameter of the thread at the back of the flange, at an angle of approximately 45° with the axis of the thread for the purpose of easy entrance in making a joint and for the protection of the thread. The chamfer shall be concentric with the thread.

10.1.2 The gauging notch of a working gauge should come flush with the bottom of the chamfer and the maximum allowable thread variations shall be one turn large or one turn small from the gauging notch.

10.2 Cast iron pipe flanges and flanged fittings over 610 mm are not screwed fittings and shall be secured by other methods when used.

11. FLANGE FACING

11.1 Flanges and flanged fittings shall be plain-faced and shall be machined to a tool-mark finish with a feed of approximately 1 mm.

NOTE — In all cases where a cast iron flange is bolted to a steel flange, the latter should be plain-faced, that is, without a projection or raised face.

*Basic profile, dimensions and tolerances for line-pipe threads for pipe fittings for petroleum industry (Under preparation) (since printed in 1967 and split into parts).

12. FLANGE BOLT HOLES

12.1 Bolt holes shall be in multiples of four so that fittings may be made to face any quarter. The bolt holes shall straddle the centre lines. The bolt holes shall be drilled as follows:

	Nominal Size of Bolt
For bolts up to and including 45 mm	+3 mm
For bolts over 45 mm	+6 mm

13. SPOT-FACING

13.1 Flanges — The bolt holes of flanges shall not be spot-faced for ordinary service except in cases given under **13.1.1** to **13.1.4.**

13.1.1 Rough flanges 305 mm and smaller which are oversize more than 3 mm in thickness after facing shall be spot-faced to the minimum thickness of flange given in Table 1 with a plus tolerance of 1·5 mm.

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13.1.3 Rough flanges 762 mm and larger which are oversize more than 6·5 mm in thickness after facing shall be spot-faced to the minimum thickness of flange given in Table 1 with a plus tolerance of 3 mm.

13.1.4 Where the finish at the back of the flange is such that the bolt head or nut does not bear evenly on the flange surface, the back shall be spot-faced; but such spot-facing shall not reduce the flange thickness below the minimum specified.

13.2 Fittings — The bolt holes of the flanges on cast iron fittings need not be spot-faced on sizes smaller than 457 mm for ordinary service, except as indicated in **13.1.** The bolt holes of all flanges on fittings 457 to 610 mm inclusive, shall be spot-faced to the specified thickness of the flange with a plus tolerance of 1·5 mm and of all flanges on fittings of sizes 762 to 914 mm inclusive, they shall be spot-faced to the tolerance of 3 mm.

14. REINFORCEMENT OF CROSSES AND LATERALS

14.1 Crosses and laterals (Y-branches), both equal and reducing shall, where necessary, be reinforced to compensate for the inherent weakness in the casting design.

15. DRAIN TAPPINGS

15.1 Holes shall be tapped in the wall of a fittings, if the metal thickness is sufficient to provide the effective length of thread specified below:

Size of tapped hole, mm	9·5	13·0	19·0	25·0	32·0	38·0	51·0
Length of thread *A* (*see* Fig. 2), mm	10·41	13·46	13·97	17·27	18·03	18·28	19·30

15.1.1 Where the thread length is insufficient, or the size of tapping is larger than that given below, a boss shall be added:

Size of fitting, mm	53-78	102-127	152	203	255	305	356-610
Size of tapped hole, mm	9·5	13·0	19·0	25·0	32·0	38·0	51·0

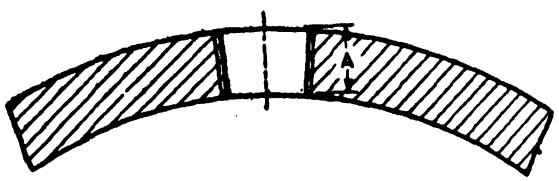

FIG. 2 DRAIN TAPPING

15.2 The method of designating the locations of the tapped holes for drains shall be as indicated in Fig. 3 (*see* P 12). Each possible location shall be designated by a letter so that desired locations for the various types of fittings may be specified definitely without the use of further sketches or descriptions.

16. BOLTS AND NUTS

16.1 The size of bolt heads and nuts shall conform to the dimensions given in Table 9 (*see* P 26).

16.1.1 For bolts 45 mm in diameter and larger, stud bolts with a nut on each end are recommended.

16.2 All bolts, stud bolts and nuts shall be threaded with screw threads in accordance with IS: 1362-1962* and IS: 1330-1958†.

17. HYDRAULIC TEST

17.1 When specified by the purchaser, cast iron flanged fittings shall withstand, without showing leaks, hydraulic pressures equal to twice the rated steam pressure given in **3.1**.

18. PROTECTIVE COATING

18.1 If required by the purchaser, after inspection, flanges and flanged fittings shall be thoroughly cleaned; and threaded and machined parts shall be treated with a suitable rust-preventing composition.

19. MARKING

19.1 All loose flanges and flanged fittings shall be marked with the manufacturer's name or trade-mark. Fittings shall also have marks cast or stamped on them indicating clearly the saturated steam service pressure ratings.

19.2 The flanges and flanged fittings may also be marked with the ISI Certification Marks.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

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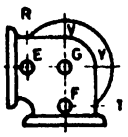
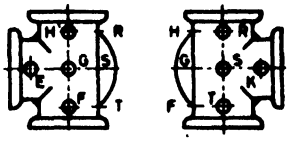
*Dimensions for screw threads for general purposes (diameter range 1·6 to 39 mm) (*revised*).

†General plan for metric screw threads with ISO profile (diameter range 0·25 to 300 mm). (Since withdrawn).



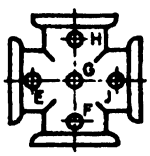
Front View Side View

SIDE-OUTLET ELBOW EQUAL SIZE

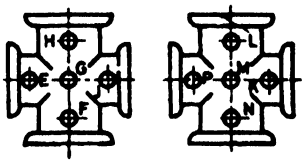


Front View Side View

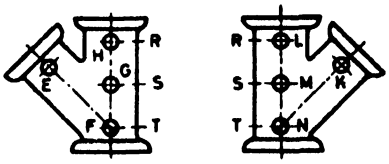
SIDE-OUTLET TEE EQUAL SIZE



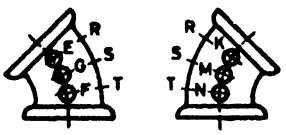
Cross Equal Size



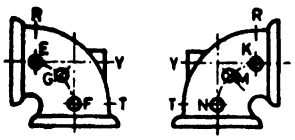
Cross Reducing Size



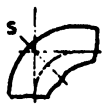
45° Lateral Equal Size



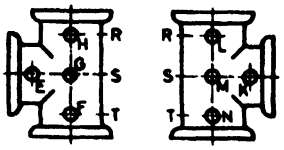
45° Elbow



90° Elbow Equal Size



90° Elbow



Tee Equal Size

(Continued)

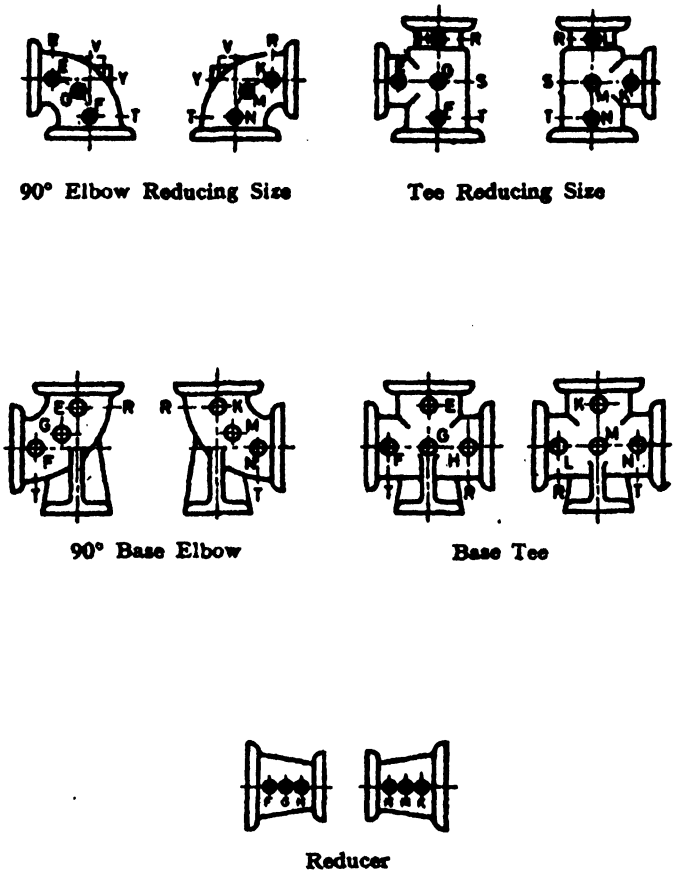


FIG. 3 METHOD OF DESIGNATING LOCATION OF TAPPED HOLES FOR DRAINS

TABLE 1 DIMENSIONS OF FLANGES, BOLTS AND SOLID FLAT FACE GASKETS

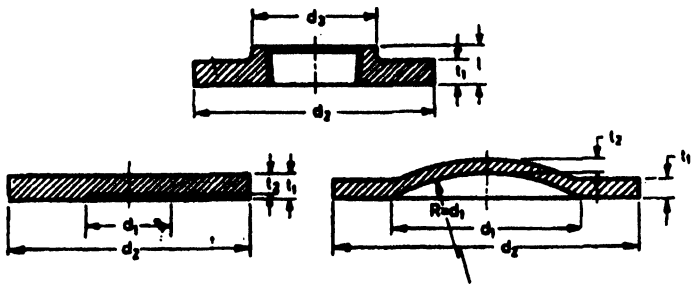
(*Clauses* 6.1, 9.2, 13.1.1, 13.1.2 *and* 13.1.3)

Nominal Pipe Size	Diameter of Flange	Thickness of Flange, *Min*	Diameter of Bolt Circle	Number of Bolts	Diameter of Bolt Holes	Size of Bolts	Length of Headed Bolts	Size of Gasket	
								Extending to Bolts	Full Face
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
mm	mm	mm	mm		mm	mm	mm	mm	mm
27	108	11	79	4	14	12	45	27 × 67	27 × 108
35	117	13	89	4	14	12	50	35 × 77	35 × 117
41	127	14	98	4	14	12	50	41 × 86	41 × 127
53	152	16	121	4	18	16	60	53 × 105	53 × 152
63	178	17	140	4	18	16	65	63 × 121	63 × 178
78	190	19	152	4	18	16	65	78 × 136	78 × 190
90	216	21	178	8	18	16	70	90 × 162	78 × 216
102	229	24	190	8	18	16	75	102 × 174	102 × 229
127	254	24	216	8	22	20	75	127 × 196	127 × 254
152	279	25	241	8	22	20	80	152 × 221	152 × 279
203	343	29	298	8	22	20	90	203 × 271	203 × 343
255	406	30	362	12	26	24	95	255 × 338	255 × 406
305(324 *D*)	483	32	432	12	26	24	95	305 × 408	305 × 48[illegible]
356 *D*	533	35	476	12	30	27	110	356 × 446	356 × 53[illegible]
406 *D*	597	37	540	16	30	27	115	406 × 510	406 × 597
457 *D*	635	40	578	16	33	30	120	457 × 545	457 × 635
508 *D*	698	43	635	20	33	30	130	508 × 602	508 × 698
610 *D*	813	48	749	20	36	33	140	610 × 713	610 × 813
762 *D*	984	54	914	28	36	33	160	762 × 878	762 × 984
914 *D*	1 168	60	1 086	32	42	39	180	914 × 1 047	914 × 1 168

NOTE — *D* indicates nominal outside diameter of pipe.

TABLE 2 DIMENSIONS OF SCREWED COMPANION AND BLIND FLANGES

(*Clauses* 6.1 *and* 9.2)



For Sizes 255 mm and Smaller For Sizes 305 mm and Larger

Nominal Pipe Size	Diameter of Port (*see* Note 2), d_1	Diameter of Flange d_2	Thickness of Flange, *Min* t_1	Wall Thickness t_2	Diameter of Hub, *Min* d_3	Length of Hub and Threads, *Min* l
(1)	(2)	(3)	(4)	(5)	(6)	(7)
mm	mm	mm	mm	mm	mm	mm
27	27	108	11	9	49	17
35	35	117	13	11	59	21
41	41	127	14	13	65	22
53	53	152	16	14	78	25
63	63	178	17	16	90	29
78	78	190	19	17	108	31
90	90	216	21	19	122	32
102	102	229	24	22	135	33
127	127	254	24	22	164	37
152	152	279	25	24	192	40
203	203	343	29	27	246	44
255	255	406	30	29	303	49
305(324 *D*)	305	483	32	21	357	56
356 *D*	356	533	35	22	391	57
406 *D*	406	597	37	25	444	63
457 *D*	457	635	40	27	498	68
508 *D*	508	698	43	29	552	73
610 *D*	610	813	48	32	660	83
762 *D*	762	984	54	37	—	—
914 *D*	914	1 168	60	41	—	—

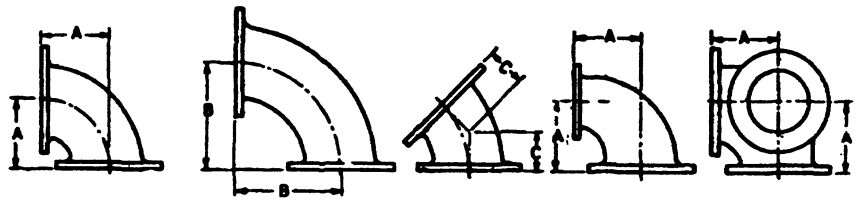
NOTE 1 — For drilling dimensions, *see* Table 1.

NOTE 2 — All blind flanges for pipe sizes 305 mm and above shall be dished with inside radius equal to the inside diameter of the fitting. The wall thickness shall at no point be less than 87·5 percent of the dimensions given in the Table.

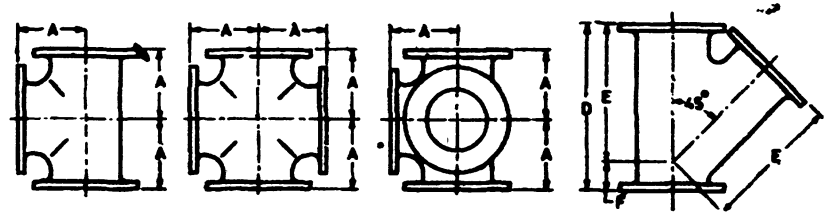
NOTE 3 — *D* indicates nominal outside diameter of pipe.

TABLE 3 DIMENSIONS OF ELBOWS, TEES, CROSSES, LATERALS, REDUCERS, TRUE Y's AND DOUBLE-BRANCH ELBOWS

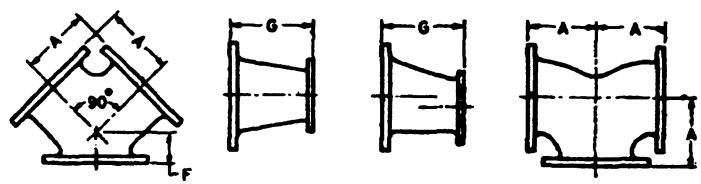
(*Clauses* 6.1, 8.1.1, 8.1.2, 8.1.3, 8.2.1, 8.2.2, 8.2.3, 8.3 *and* 8.4)



90° Elbow | 90° Long Radius Elbow | 45° Elbow | Reducing Elbow | Side-Outlet Elbow



Tee | Cross | Side-Outlet Tee or Cross | Lateral



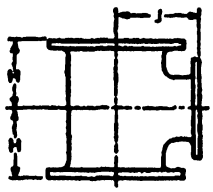
True Y | Reducer | Eccentric Reducer | Double-Branch Elbow

Nominal Pipe Size	Inside Diameter of Fittings	Centre-to-Face Elbows, Tees, Crosses; Y Double-Branch Elbows, *A*	Centre-to-Face Long True Radius Elbow, *B*	Centre-to-Face 45° Elbow, *C*	Face-to-Face Tees and Crosses, *A* + *A*	Face-to-Face Lateral, *D*	Centre-to-Face Lateral, *E*	Short Centre-to-Face True Y and Lateral, *F*	Face-to-Face Reducer, *G*	Diameter of Flange	Thickness of Flange, *Min*	Wall Thickness
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
27	27	89	127	44	178	190	146	44	—	108	11	8
35	35	95	140	51	190	203	159	44	—	117	13	8
41	41	102	152	57	204	229	178	51	—	127	14	8
53	53	114	165	63	228	267	203	63	127	152	16	11
63	63	127	178	76	254	305	241	63	140	178	17	11
78	78	140	197	76	280	330	254	76	152	190	19	11
90	90	152	216	89	304	368	292	76	165	216	21	11
102	102	165	229	102	330	381	305	76	178	229	24	13
127	127	190	260	114	380	432	343	89	203	254	24	13
152	152	203	292	127	406	457	368	89	229	279	25	14
203	203	229	356	140	458	559	444	114	279	343	29	16
255	406	279	419	165	558	648	521	127	305	406	30	19
305(324 *D*)	305	305	484	190	610	762	622	140	356	483	32	21
356 *D*	356	356	546	190	712	838	686	152	406	533	35	22
406 *D*	406	381	610	203	762	927	762	165	457	597	37	25
457 *D*	457	419	673	216	838	991	813	178	483	635	40	27
508 *D*	508	457	737	241	914	1 092	889	203	508	698	43	29
610 *D*	610	559	864	279	1 118	1 257	1 029	229	610	813	48	32
762 *D*	762	635	1 054	381	1 270	1 499	1 245	254	762	984	54	37
914 *D*	914	711*	1 245	457	1 422	—	—	—	914	1 168	60	41

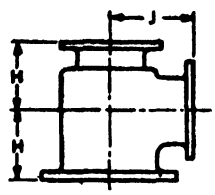
NOTE 1 — For drilling dimensions, *see* Table 1.
NOTE 2 — *D* indicates nominal outside diameter of pipe.
*Does not apply to true Y's or double-branch elbows.

TABLE 4 DIMENSIONS OF REDUCING TEES AND REDUCING CROSSES (SHORT-BODY PATTERNS)

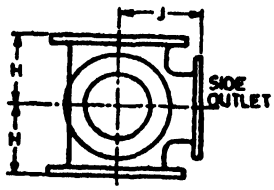
(*Clauses* 6.1, 8.2.3 *and* 9.2)



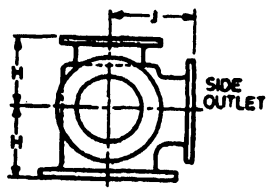
Tee Reducing on Outlet



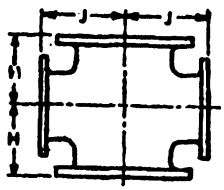
Tee Reducing on One Run and Outlet



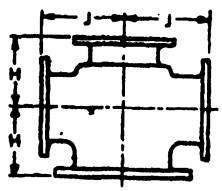
Side-Outlet Tee or Cross Reducing on Outlet



Side-Outlet or Cross Reducing on One Run and Outlets



Cross Reducing on Outlets



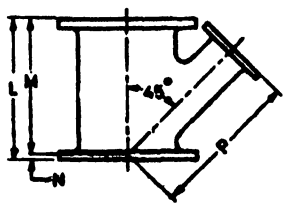
Cross Reducing on One Run and Outlets

NOMINAL PIPE SIZE	OUTLET SIZES UP TO AND INCLUDING	CENTRE-TO-FACE RUN, H	FACE-TO-FACE RUN, $H+H$	CENTRE-TO-FACE OUTLET J
(1)	(2)	(3)	(4)	(5)
mm	mm	mm	mm	mm
All reducing fittings, sizes 406 mm and smaller, have same face-to-face and centre-to-face dimensions as in the case of equal sizes, *see* Table 3.				
457 *D*	305	330	660	394
508 *D*	356	350	700	432
610 *D*	406	381	762	483
762 *D*	508	457	914	584
914 *D*	610	508	1 016	660

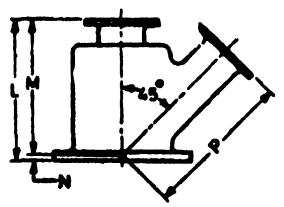
NOTE 1 — *D* indicates nominal outside diameter of pipe.
NOTE 2 — For all other dimensions, *see* Table 3.

TABLE 5 DIMENSIONS OF REDUCING LATERALS (SHORT-BODY PATTERNS)

(*Clauses* 6.1, 8.2.3 *and* 9.2)



45° Lateral Reducing on Branch



45° Lateral Reducing on One Run and Branch,

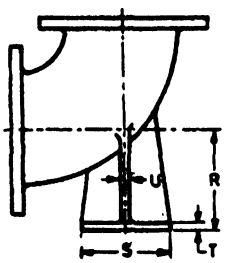
NOMINAL PIPE SIZE	BRANCH SIZE UP TO AND INCLUDING	FACE-TO-FACE RUN, *L*	CENTRE-TO-FACE RUN, *M*	CENTRE-TO-FACE RUN, *N*	CENTRE-TO-FACE BRANCH, *P*
(1)	(2)	(3)	(4)	(5)	(6)
mm	mm	mm	mm	mm	mm
All reducing fittings, sizes 406 mm and smaller, have same face-to-face and centre-to-face dimensions as in the case of equal sizes, *see* Table 3.					
457 *D*	203	660	635	25	698
508 *D*	254	711	686	25	749
610 *D*	305	813	800	13	876
762 *D*	356	991	991	0	1 067

NOTE 1 — *D* indicates nominal outside diameter of pipe.

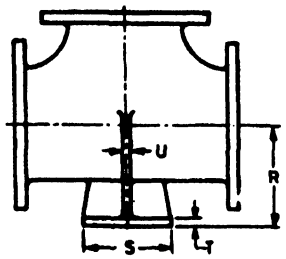
NOTE 2 — For all other dimensions, *see* Table 3.

TABLE 6 DIMENSIONS OF BASE ELBOWS AND BASE TEES

(*Clauses* 6.1 *and* 9.2)



Base Elbow



Base Tee

Round Base

Square Base

Nominal Pipe Size	Centre to Base, *R*	Diameter of Round Base or Side of Square Base, *S*	Thickness of Base, *T*	Thickness of Ribs, *U*	Base Drilling		Size of Support Pipe
					Bolt Circle, *W*	Diameter of Drilled Holes	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
mm	mm	mm	mm	mm	mm	mm	mm
27	89	98	11	10	70	14	19
35	92	98	11	10	70	14	19
41	95	108	11	13	79	14	25

(*Continued*)

TABLE 6 DIMENSIONS OF BASE ELBOWS AND BASE TEES — *Contd*

Nominal Pipe Size	Centre to Base, *R*	Diameter of Round Base or Side of Square Base, *S*	Thickness of Base, *T*	Thickness of Ribs, *U*	Base Drilling		Size of Support Pipe
					Bolt Circle, *W*	Diameter of Drilled Holes	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
mm	mm	mm	mm	mm	mm	mm	mm
53	105	117	13	13	89	14	32
63	114	117	13	13	89	14	32
78	124	127	14	13	98	14	38
90	133	127	14	13	98	14	38
102	140	152	16	13	121	18	51
127	159	178	17	16	140	18	63
152	178	178	17	16	140	18	63
203	222	229	24	22	190	18	102
255	248	229	24	22	190	22	102
305(324 *D*)	286	279	25	25	241	22	152
356 *D*	317	279	25	25	241	22	152
406 *D*	349	279	25	25	241	22	203
457 *D*	381	343	29	29	298	22	203
508 *D*	406	343	29	29	298	22	203
610 *D*	470	343	29	29	298	22	203

NOTE 1 — The bolt-hole template shown for a round base is the same as for the flange of the corresponding size of supporting pipe, except that only four holes are used in all cases, so placed as to straddle the centre lines. The bases of these fittings are intended for support in compression and shall not be used for anchors or supports in tension or shear.

NOTE 2 — The base dimensions apply to all equal and reducing sizes.

NOTE 3 — For reducing fittings the size and centre-to-face dimension of base are determined by the size of the largest opening of the fittings. In the case of reducing base elbows, orders shall specify whether the base is to be opposite the larger or smaller opening.

NOTE 4 — For tees of sizes larger than 610 mm anchorage fittings are recommended, *see* Tables 7 and 8.

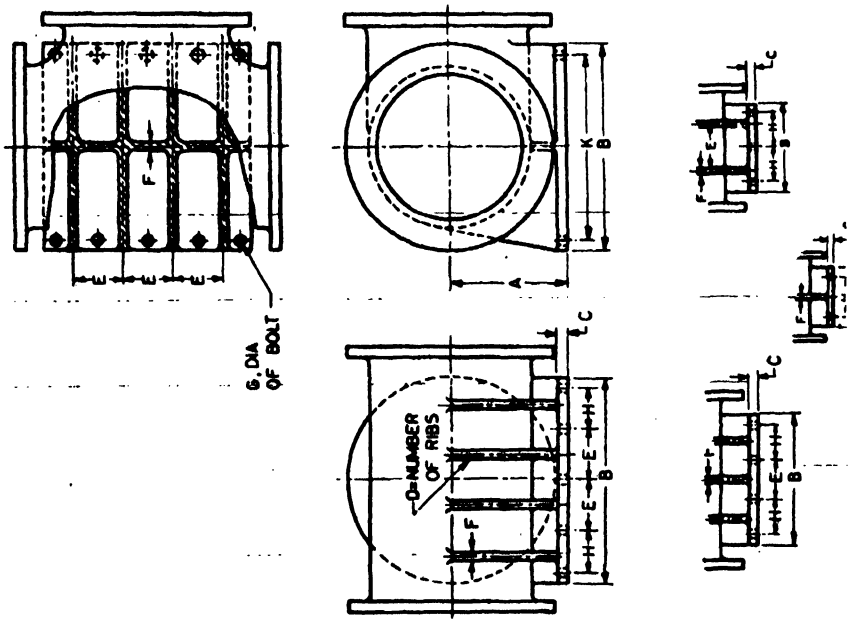
NOTE 5 — For fittings dimensions, *see* Tables 3 and 4.

NOTE 6 — Unless otherwise specified, the bases are not supplied machined.

NOTE 7 — *D* indicates nominal outside diameter of pipe.

TABLE 7 DIMENSIONS OF ANCHORAGE BASES FOR TEES (EQUAL SIZES)

(*Clauses* 6.1 *and* 9.2)



Nominal Pipe Size	Centre to Base, *A*	Side of Square Base, *B*	Thickness of Base, *C*	Number of Ribs, *D*	Centres of Ribs and Bolts, *E*	Thickness of Ribs, *F*	Diameter of Bolts (*see* Note 4), *G*	Centres of Bolts, *H*	Centres of Bolts, *K*	Number of Bolt Holes on Each Side of Base
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
mm	mm	mm	mm		mm	mm	mm	mm	mm	
63	114	178	17	1	—	11	16	114	114	2
78	124	190	19	1	—	11	16	127	127	2
90	133	216	21	1	—	11	16	152	152	2
102	140	229	24	2	108	13	16	83	165	3
127	159	254	24	2	127	13	24	95	190	3
152	178	279	25	2	152	14	24	111	222	3
203	213	343	29	3	203	16	27	140	279	3
255	248	406	30	3	124	19	30	108	340	4
305(324 *D*)	286	483	32	3	146	21	33	124	394	4
356 *D*	317	533	35	3	171	22	33	140	451	4
406 *D*	349	597	37	3	197	25	36	152	502	4
457 *D*	381	635	40	3	216	27	36	168	552	4
508 *D*	406	698	43	3	241	29	39	184	610	4
610 *D*	470	813	48	3	289	32	42	216	721	4
762 *D*	559	984	54	4	238	37	45	200	876	5
914 *D*	648	1 168	60	4	286	41	48	232	1 035	5

NOTE 1 — *D* indicates the nominal outside diameter of pipe.

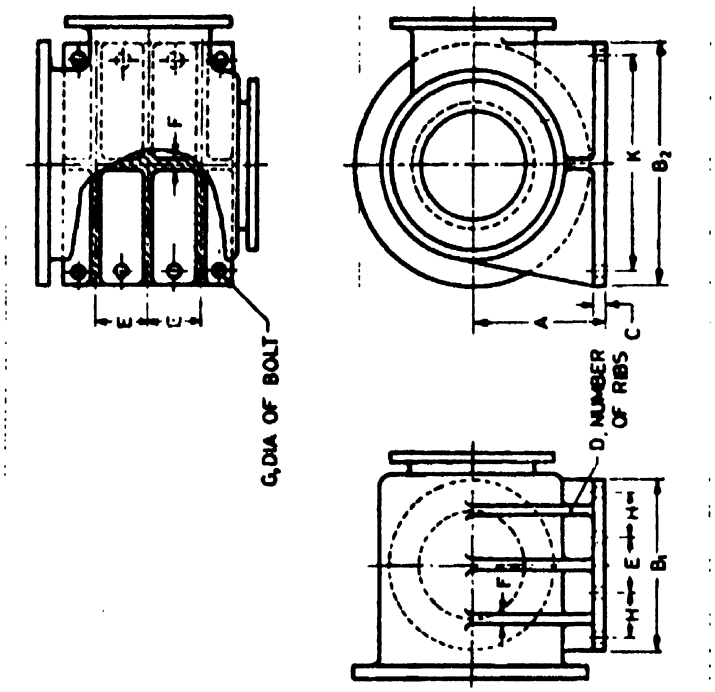
NOTE 2 — Unless otherwise specified the bases are not supplied machined.

NOTE 3 — For the tee dimensions, *see* Table 3.

NOTE 4 — For diameters of bolt holes, *see* 12.1.

TABLE 8 DIMENSIONS OF ANCHORAGE BASES FOR REDUCING TEES (SHORT-BODY PATTERN)

(*Clauses* 6.1 *and* 9.2)



Nominal Pipe Size	Outlet Sizes up to and Including	Centre to Base, A	Length of Base, B_1	Width of Base, B_2	Thickness of Base, C	Number of Ribs, D	Centre of Ribs and Bolts, E	Thickness of Ribs, F	Diameter of Bolts (*see* Note 4), G	Centre of Bolts, H	Centre of Bolts, K	Number of Bolt Holes on Each Side of Base
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
mm	mm	mm	mm	mm	mm		mm	mm	mm	mm	mm	
457 *D*	305	381	483	635	40	3	133	27	33	130	546	4
508 *D*	356	406	533	698	43	3	152	29	33	137	591	4
610 *D*	406	470	597	813	48	3	178	32	36	159	711	4
762 *D*	508	559	698	984	54	3	229	37	39	184	883	4
914 *D*	610	648	813	1 168	60	3	273	41	39	213	1 054	4

NOTE 1 — D indicates nominal outside diameter of pipe.

NOTE 2 — Unless otherwise specified, the bases are not supplied machined.

NOTE 3 — For size 457 mm and above, if the outlet is the same or smaller than that given in Table 4 (short-body pattern), the base dimensions shown in the above table shall be used. If the outlet is larger than that shown in Table 4, the base dimensions shall be the same as for the equal-size tee shown in Table 7, corresponding to the size of the largest opening.

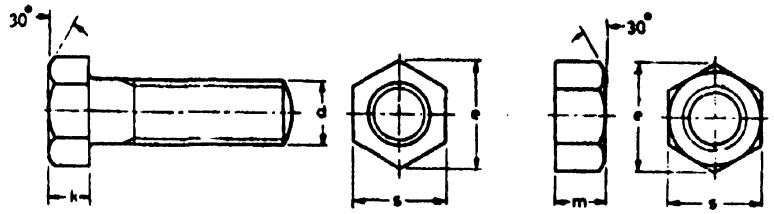
Tees reducing on run only shall have the same base dimensions as equal-size tees shown in Table 7, corresponding to the size of the largest opening.

NOTE 4 — For the reducing tee dimensions, *see* Table 4.

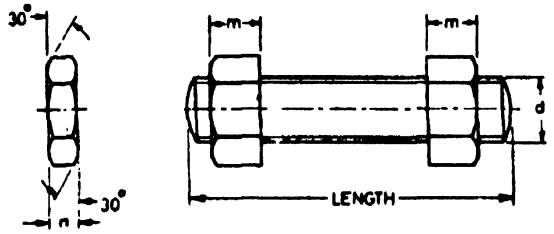
NOTE 5 — For diameter of bolt holes, *see* 12.1.

TABLE 9 DIMENSIONS OF BOLT HEADS AND NUTS (METRIC)

(*Clause* 16.1)



Bolt Nut



Lock-Nut Stud

Nominal Size of Bolts and Stud Bolts, *d*	Width Across Flats, *s*	Width Across Corners, *Max* *e*	Thickness of Heads, *k*	Thickness of Nuts, *m*	Thickness of Lock-Nuts, *n*
(1)	(2)	(3)	(4)	(5)	(6)
min	mm	mm	mm	mm	mm
12	19	21·9	8·0	10	7·0
16	24	27·7	10·0	13	8·0
20	30	34·6	13·0	16	9·0
24	36	41·6	15·0	19	10·0
27	41	47·3	17·0	22	12·0
30	46	53·1	19·0	24	12·0
33	50	57·7	21·0	26	14·0
36	55	63·5	23·0	29	14·0
39	60	69·3	25·0	31	16·0
42	65	75·0	26·0	34	34·0
45	70	80·8	28·0	36	34·0
48	75	86·5	30·0	38	38·0

APPENDIX A
(*Clause* 0.3)

APPROXIMATE WEIGHTS OF CAST IRON, FLANGES AND FITTINGS

TABLE 10 APPROXIMATE WEIGHTS OF FLANGES, ELBOWS, CROSSES, TEES AND LATERALS

Nominal Pipe Size	Companion Flange	Blind Flange	90° Elbow	45° Elbow	90° Long Radius Elbow	Side Outlet Elbow	90° Elbow		Tees	Cross* Not Ribbed	Lateral* Not Ribbed
							Square Base	Round Base			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
mm	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg
27	0·91	0·91	—	—	—	—	—	—	—	—	—
35	0·91	1·44	—	—	—	—	—	—	—	—	—
41	1·36	1·36	4·08	3·63	—	—	—	—	6·86	—	—
53	2·27	2·28	6·35	5·44	7·26	—	—	—	9·52	12·70	11·34
63	3·17	3·17	8·62	7·71	10·43	—	—	—	13·61	17·69	16·33
78	3·63	4·08	10·89	9·07	12·70	—	—	—	16·78	21·77	19·96
90	4·99	5·44	14·06	12·25	16·78	—	—	—	22·23	—	—
102	6·45	7·26	18·6	16·33	21·77	26·76	27·21	25·85	29·03	37·19	34·02
127	7·71	9·07	23·59	20·41	28·12	33·56	34·47	33·11	36·74	47·63	43·54
152	9·98	11·34	30·84	27·21	38·55	43·54	41·28	39·92	47·63	61·23	56·7
203	14·06	19·05	49·89	42·64	65·77	68·04	74·84	72·57	74·84	95·26	95·25
255	20·41	28·58	79·38	65·77	104·33	108·86	111·13	105·23	122·47	149·69	154·22
305(324 *D*)	28·58	39·92	113·4	99·79	158·76	154·22	163·75	146·96	172·36	—	255·87
356 *D*	37·19	52·16	158·76	122·47	213·19	—	—	—	240·40	—	—
406 *D*	47·63	72·57	213·19	163·29	303·91	—	—	—	317·57	—	—
457 *D*	54·43	86·18	283·08	190·51	381·02	—	—	—	390·09	—	—
508 *D*	68·04	113·4	335·66	244·94	489·88	—	—	—	498·95	—	—
610 *D*	99·79	167·83	526·17	362·87	743·89	—	—	—	784·71	—	—

NOTE 1 — *D* indicates nominal outside diameter of pipe.
NOTE 2 — All weights are for flanges and fittings faced and drilled.
*Weights of crosses and laterals do not include reinforcing ribs.

TABLE 11 APPROXIMATE WEIGHTS OF REDUCING 90° ELBOWS AND REDUCING 90° LONG RADIUS ELBOWS

(*Clause* 0.3)

Nominal Pipe Size	Reducing 90° Elbow	Reducing 90° Long Radius Elbow	Nominal Pipe Size	Reducing 90° Elbow	Reducing 90° Long Radius Elbow
(1)	(2)	(3)	(1)	(2)	(3)
mm × mm	kg	kg	mm × mm	kg	kg
53 × 32	5·90	—	152 × 78	21·32	—
63 × 53	9·07	—	203 × 152	40·82	61·69
78 × 63	9·98	11·79	203 × 127	37·19	53·52
78 × 53	8·62	10·43	203 × 102	34·93	—
102 × 78	14·97	22·68	255 × 203	68·04	92·98
102 × 63	14·06	—	255 × 152	56·70	—
102 × 53	13·15	—	305 × 255	99·79	145·15
127 × 102	21·77	26·31	305 × 203	86·18	—
127 × 78	18·14	—	305 × 152	47·63	—
152 × 127	27·21	35·83	356 × 305	145·15	—
152 × 102	25·40	32·66	356 × 305	172·36	—

NOTE — All weights are for fittings faced and drilled.

TABLE 12 APPROXIMATE WEIGHTS OF REDUCERS AND ECCENTRIC REDUCERS

(*Clause* 0.3)

Nominal Pipe Size	Reducer	Eccentric Reducer	Nominal Pipe Size	Reducer	Eccentric Reducer
(1)	(2)	(3)	(1)	(2)	(3)
mm × mm	kg	kg	mm × mm	kg	kg
63 × 35	5·44	—	152 × 53	15·42	—
78 × 63	8·62	—	203 × 152	34·93	34·93
78 × 53	7·26	7·26	203 × 127	32·20	—
63 × 35	6·80	—	203 × 102	29·94	—
90 × 78	10·89	—	255 × 203	54·43	54·43
102 × 90	14·06	—	255 × 152	45·36	—
102 × 78	12·70	12·70	305 × 255	81·65	81·65
102 × 63	11·79	—	305 × 203	70·31	—
102 × 53	10·89	—	305 × 152	63·50	—
127 × 102	17·69	17·69	356 × 305	113·40	—
127 × 78	14·51	—	356 × 255	99·79	—
127 × 63	14·06	—	356 × 203	90·72	—
152 × 127	22·68	22·68	356 × 152	83·91	—
152 × 102	21·32	21·32	406 × 356	154·22	—
152 × 78	17·69	—	406 × 305	140·61	—
152 × 63	16·78	—	406 × 255	127·01	—

NOTE — All weights are for fittings faced and drilled.

TABLE 13 APPROXIMATE WEIGHTS OF REDUCING TEES

(*Clause* 0.3)

Size	Weight	Size	Weight
(1)	(2)	(1)	(2)
mm × mm	kg	mm × mm	kg
53 × 53 × 41	9·52	152 × 53 × 152	40·82
63 × 63 × 53	14·06	203 × 203 × 152	72·57
78 × 78 × 63	16·33	203 × 203 × 127	71·67
78 × 78 × 53	14·97	203 × 203 × 102	70·31
78 × 78 × 35	14·06	203 × 203 × 78	63·96
78 × 63 × 78	15·88	203 × 152 × 203	70·31
78 × 63 × 63	15·42	203 × 152 × 152	63·50
78 × 53 × 78	14·97	203 × 152 × 127	61·23
78 × 53 × 53	13·15	203 × 152 × 102	58·97
63 × 63 × 78	15·42	203 × 152 × 78	60·33
102 × 102 × 78	25·85	203 × 127 × 203	68·04
102 × 102 × 63	24·95	203 × 102 × 203	68·04
102 × 102 × 53	24·04	203 × 102 × 152	61·23
102 × 102 × 35	24·04	255 × 255 × 203	120·66
102 × 78 × 102	25·85	255 × 255 × 152	117·93
102 × 78 × 78	22·68	255 × 255 × 127	115·21
102 × 63 × 102	25·40	255 × 255 × 102	111·58
102 × 63 × 78	22·23	255 × 255 × 78	108·86
102 × 63 × 63	21·32	255 × 203 × 255	117·93
102 × 53 × 102	24·49	255 × 203 × 203	108·86
127 × 127 × 102	35·38	255 × 203 × 152	99·79
127 × 127 × 78	31·75	305 × 305 × 255	163·29
127 × 127 × 63	30·84	305 × 305 × 203	160·57
127 × 127 × 53	30·84	305 × 305 × 152	154·22
127 × 102 × 127	35·38	305 × 305 × 127	152·41
127 × 102 × 102	34·02	305 × 305 × 102	146·06
152 × 152 × 127	44·90	305 × 255 × 305	167·83
152 × 152 × 102	43·54	305 × 255 × 255	154·22
152 × 152 × 78	40·37	305 × 255 × 203	145·15
152 × 152 × 63	39·92	305 × 255 × 152	140·61
152 × 152 × 53	39·46	305 × 203 × 305	158·76
152 × 127 × 152	45·36	305 × 203 × 203	140·61
152 × 127 × 127	43·09	356 × 356 × 203	208·65
152 × 127 × 102	41·73	78 × 78 × 102	23·13
152 × 102 × 152	44·45	102 × 102 × 152	38·55
152 × 102 × 102	40·37	102 × 102 × 127	34·02
152 × 102 × 78	37·19	127 × 127 × 152	43·09
152 × 78 × 152	41·73	152 × 152 × 203	58·97
152 × 78 × 102	37·65	203 × 203 × 255	99·79
152 × 78 × 78	34·47	255 × 255 × 305	151·95